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Resilience to climate change impact on water resources and environment (A case study Najaf sea)

Alamri N. abdulhadi* and Alrawi A. Khairy

Urban and Regional Planning, Centre of Urban and Regional Planning for Post Graduate Studies, University of Baghdad, Baghdad, Iraq.
*Corresponding author's e-mail: nabaa.Abdulhadi1200c@iurp.uobaghdad.edu.iq;dr.areej@iurp.uobaghdad.edu.iq

Climate change is affecting all habitats and faucets of life, rural as well urban environs. Urban localities are the main contributors to global warming due to the carbon emissions released through human intervention in the climate system. City dwellers also become the victims of climate change and natural vagaries, Climate change disasters. In order to reduce these risks, cities have adopted strategies to enhance their resilience to climate change disasters and to create resilience. In this context, the United Nations has adopted several legal tools, most notably the Framework Convention on Climate Change. However, these tools have not been effective due to the minimal role of the organizations responsible. Also, the inability of major nations to meet their obligations in decreasing greenhouse gas emissions constitutes a primary contributor to the hazards endangering the survival of urban habitants. The aim of the research study was also to demonstrate the impact of resilience in reducing climate change and mitigating its effects, thereby increasing the elasticity of the environmental system.
Keywords: Environment, climate change, resilience, disasters mitigation and adaptation.

INTRODUCTION

Human-induced climate change is occurring at an unparalleled pace, resulting in the degradation of the environment and the extinction of various species. It also exacerbates environmental risks, modifies the ecosystem, and results in the loss of living organisms. Climate change poses a global challenge that threatens ecological systems, biodiversity, and livelihoods. Nonetheless, the impact of climate change is especially severe on impoverished communities that rely on climate-related industries chief among which are agriculture, animal husbandry, and ecotourism to sustain their livelihoods. They are highly vulnerable and suffer from the effects of environmental changes.

***Climate Change*:** The term "climate change" is used to describe the long-term changes in global temperatures and weather conditions. Although some of these changes can be attributed to natural reasons like solar activity, it is now commonly that human activities—specifically the combustion of fossil fuels like coal, oil, and gas are the main contributors to global warming. These activities produce greenhouse gases emissions that are like a blanket that covers the earth, trapping heat from the sun and leading to higher temperatures. This process is having a significant impact on the planet's ecosystem and biodiversity (IPCC, 2007).

There are many effects of climate change that have serious and deleterious effects worldwide effects. Such as droughts, floods, water shortages, fierce wildfires, the melting of the polar ice cap, severe storms, and the disappearance of biodiversity. Various areas of our existence, including our health, the ability to cultivate food, safety, housing, and employment, have been impacted by climate change. For instance, extended periods of drought have prompted people to migrate, while the rise in sea levels and the entrance of saltwater have caused entire villages to shift. According to (IPCC, 2007) climate change is a global challenge that affects all aspects of life and is caused by changes in temperature, whether they are natural or human-induced.

***The Impact of Climate Change on Ecosystem*:** According to a report by the Intergovernmental Panel on Climate Change (IPCC, 2007), climate change has caused significant changes in physical and biological systems at regional levels, particularly with regards to rising temperatures. Additionally, one in every four mammalian species was at risk of serious decline in their survival chances. Climate change has led to an increase in genetic resource migration rates and altered how plant genetic resources are distributed making it

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challenging for these resources to adjust to the new climatic conditions (Lynch, 1993).

***The Impact of Climate Change on Water Resources*:** Changes in climate result in changes in the amount of precipitation, surface runoff, water bodies, and evapotranspiration. The effect on the quality of water particularly in the event of significant rise in weather events like droughts and floods is also popular. groundwater recharge rates, groundwater levels, and erratic rainfall in arid regions can increase groundwater recharge as it is able to infiltrate before evaporation are very common (Pachauri, 2008). The consequences of climate elements on water resources in arid as well as semi-arid regions is evident given the limited resources.

Water resources, whether surface or those underneath, are affected by climate variations, such as temperature changes. Warmer temperatures, when combined with high phosphorus concentrations in water bodies such as lakes and reservoirs, can lead to increased algae growth that affects water quality through color, odor, and taste. This may result in poisoning cases for humans, livestock, and wildlife. The cost of treating contaminated water is high with the available technology (Pachauri, 2008).

Impact of climate change on urban areas: The expected population growth, especially in coastal areas, and the increase in urban expansion not only led to higher levels of demand for water resources, but also to a deterioration in the quality and type. Floods, which are expected to be more frequent, can also lead to a decrease in available water resources due to damage to the supply network, inadequate drinking water, and an impact on the distribution infrastructure (Kalkuhl and Wenz, 2020).

The main threats facing urban areas, equivalent to one billion inhabitants of developing countries, can be summarized as follows (Costanza *et al.*, 2008):

- Severe shortage of fresh water.
- Seepage of saline water into coastal agricultural land, leading to an increase in soil salinity.
- Decrease in rainfall quantities and their concentration within a shorter time frame.
- Increased evaporation rate of water from the land, resulting in less rainfall reaching the rivers.
- Relocation of coastal populations threatened with drowning.

***The role of climate change in the deterioration of the ecological system*:** According to scientific evidence, the frequency and intensity of climate-related disasters including floods, fires, and droughts are on the increase. Approximately 60% of all ecosystem services are deteriorating or being used in an unsustainable manner (Easterling *et al.*, 2000). As a result of the climate and environmental alterations caused by human actions such as excessive consumption, contamination, modified land and oceanic utilization, these ecological systems encounter unparallel challenges, leaving the majority of the services they offer open to peril (Fremier *et al.*, 2015).

***Resilience To Climate Change In Aquatic Ecosystems*:** Coastal marine ecosystems offer various essential ecological services, such as safeguarding coastlines, furnishing nourishment from fishing activities and aquaculture. As the populace residing in coastal regions continues to expand, our reliance on these invaluable systems intensifies correspondingly. However, multiple human activities jeopardize the operation of coastal ecological systems (Doney et al., 2012). Figure 1 illustrates how climate change poses a risk to the supply of valuable ecological services and human welfare (Bernhardt and Leslie, 2013). The impact of climate change, such as rising temperatures and acidification, may push ecological systems towards crucial tipping points. If these thresholds are surpassed, it could result in notable transformations in the ecological system's configuration, such as the proportion of coral, and performance, such as wave reduction. This, in turn, could impact the provision and worth of ecological services, like protection from storms, thereby leading to after-effects on human welfare (Arkema and Samhouri, 2009).

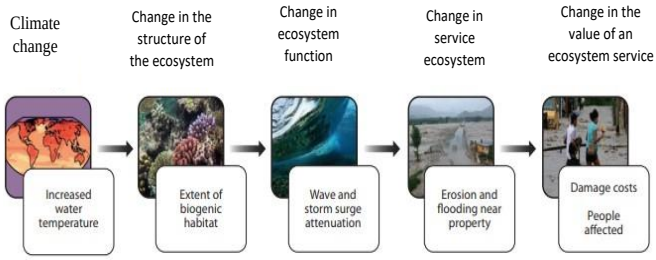

Figure 1. The relationship between climate change and ecosystem services (Bernhardt and Leslie, 2013)

***Strategies to build resilience to weather disasters changes*:** There are various guidelines for developing the ability to deal with climate change disasters, which encompass a range of measures that can be taken to confront the impacts of climate change, such as adaptation and mitigation. Mitigation and adaptation are two potential approaches for addressing climate change, with mitigation focusing on actions that minimize exposure to changes. (Nelson, Adger and Brown, 2007) reported that one way of achieving this is through regulatory policies or technological advancements. Alternatively, adaptation refers to the modifications that individuals make in response to existing or anticipated alterations. The implementation of ecosystem-centered adaptation techniques has the potential to alleviate the consequences of climate hazards. Enhancing resilience and decreasing climate vulnerability can be achieved through means such as insurance coverage and diversification of livelihoods. Furthermore, constructing more hazard-resistant

infrastructure can strengthen social protection and reduce climate vulnerability (Adler *et al.*, 2022).

Many studies and research have developed probabilities for mitigation. The Third Working Group of the Intergovernmental Panel on Climate Change (IPCC) produced the Special Report on Renewable Energy Sources and Climate Change Mitigation (SRREN) with the primary aim of conducting a thorough and in-depth assessment and analysis of how renewable energy technology can reduce greenhouse gas emissions and tackle the difficulties caused by climate change. The report scrutinizes the current status of renewable energy technology and its capacity to aid in climate change mitigation initiatives. Policymakers and decision-makers in the energy and environmental fields can use the report's findings and recommendations as a crucial point of reference. As per the report's findings, renewable energy has substantial potential to alleviate the impacts of climate change. The report highlights that renewable energy can make a significant contribution to economic and social development while also ensuring a dependable energy supply, minimizing detrimental effects on the environment and public health if executed suitably (Field, 2012).

***Environmental systems in lessening the effects of calamities*:** Given that many environmental systems around the world are already deteriorating, Environmental planners are trying to preserve and sustainably manage these systems in order to reduce vulnerability resulting from environmental degradation, and thus reduce the risks of disasters. Ecological systems furnish vital and essential services for human welfare and have the potential to alleviate particular types of natural hazards by acting as natural barriers. However, ~~we~~ it must be acknowledged that not all risks can be effectively mitigated through environmental systems, such as earthquakes, and that the size of the risk can be a limiting factor (Sudmeier-Rieux *et al.*, 2019).

The loss and deterioration of environmental systems have direct links to natural hazards and disasters, The relationship between the environment and disasters is complex and can occur in multiple ways. Disasters cause significant harm to the environment, while degraded environments worsen the effects of disasters. Additionally, climate change is expected to amplify the impacts of disasters and impact the environment. Emergency responses to disasters may lead to further environmental harm due to the implementation of emergency measures without proper environmental emergency plans. By investing in proper environmental management, disaster risks can be reduced, thereby contributing to more sustainable and resilient development (Sudmeier-Rieux *et al.*, 2019).

***Adaptation Strategy*:** Adaptation refers to a series of actions and strategies aimed at minimizing the effects of climate change on natural and human systems. These efforts vary greatly, from implementing warning systems for natural disasters to modifying land use and moving homes away from coastal areas (Zaid, Mamoun and Al-Mobark, 2014). Climate Change Adaptation (CCA) pertains to the reaction to the phenomenon of global warming, which is also recognized as anthropogenic climate change. The Intergovernmental Panel on Climate Change (IPCC) delineates adaptation as "the mechanism of altering oneself to real or projected climate conditions and their aftereffects". Adaptation encompasses a diverse range of areas, such as infrastructure, as well as educational and agricultural realms (Pedersen, 2022). In the context of human systems, the primary goal of adaptation is to curtail or circumvent harm while maximizing advantageous opportunities. In certain natural systems, human intercession may bolster the process of adjusting to the anticipated climate conditions and their outcomes.

Social and economic growth are intimately related to adaptive capacity (IPCC, 2007). Since developing nations are likely to experience the worst effects of global warming, adaptation is especially crucial in these areas. The capacity for adaptation is unevenly distributed among populations and geographical areas, and poorer nations typically have lower levels of capacity

***The role of environmental management in adapting to climate change*:** Numerous environmental concerns have arisen as a result of quick technological advancement and rising population, necessitating effective environmental management to address them, discover remedies, and incorporate into the city's strategy (Yass, 2015).

Ecological systems that are properly maintained can offer natural defenses against risks from the environment, like landslides, floods, ice collapses, storms, forest fires, and droughts. Environmental system management is of paramount importance for maintaining and improving its health for the sustainability of various environmental system services that are important for people welfare. A barrier created by robust ecological systems increases the resistance of natural and societal systems to the effects of climate change and natural disasters. Following are some examples of how environmental management can help with catastrophe risk reduction and climate change adaptation (Munang *et al.*, 2010).

- Acknowledging the manifold roles and utilities furnished by ecosystems across various spatial extents: Competently-supervised ecosystems provide absolutely vital commodities and amenities that empower societies to confront and bounce back from catastrophic occurrences. Interconnecting disaster risk reduction based on ecosystems with sustainable livelihoods and development: There should be obvious societal and financial motivations for investing in choices related to ecosystem administration.
- Getting the participation of stakeholders in the local community is important for improving disaster risk reduction by means of sustainable management of the ecosystem.

***Environmental Restoration*: Our ecological systems are facing a lot of pressure** due to climate change, but we continue to add pressure to the ecological systems ability to recover by adding other pressures such as encroachment, pollution, and overharvesting. The extent of the damage caused by climate change and our ability to deal with it is constant relationship to the extent of disturbance which the ecological systems can withstand. If we want to prevent the collapse of ecological systems and improve their ability to accommodate climate change, then ecosystem restoration can be the tool, as the goal of ecosystem restoration is to contribute to the conservation and sustainable use of biodiversity, stop degradation, purify air and water, mitigate extreme weather, improve human health, as well as reduce and adapt to climate change (Kumaraswamy, Hewa Welege and Pan, 2023). To restre ecological systems, research and development efforts should be encouraged to better understand and identify how to support the key elements that promote mitigation and adaptation. Secondly, we need an improved multi-disciplinary governance model and multiple agencies to recognize the role of communities in environmental governance. Finally, we must stop causing further harm to resources and start conserving and using the remaining resources sustainably. (Harris *et al.*, 2006) reported that policies should aim to preserve and restore ecological systems. Ecosystem restoration is not limited to repair and reconstruction of parts of the earth, but it is about committing to protecting the future of the earth."

***The Land use planning in reducing the impact of climate change-related disasters*:** Local government land use plans enable the collection and analysis of information on land suitability for development, allowing policymakers, potential investors, and community members to understand the boundaries of risk-prone areas (Burby, 1998). Sustainable risk reduction encompasses a variety of mechanisms (Schwab *et al.*, 2007) which are as under:

- Land utilization planning, such as recognizing hazards and susceptibility.
- Formulating risk mitigation strategies that steer new constructions and infrastructure away from vulnerable areas and relocate constructions and activities to less perilous regions.
- Essential systems must maintain functionality during extreme circumstances.
- Safeguarding the intactness of natural systems to the greatest extent possible.
- Designing proactive awareness and education programs to improve understanding of natural hazards and the ability to deal with them.
- Prophylactic land utilization planning and administration, cautionary and evacuation provisions, assistance measures, architectural safeguarding, and other strategies.
- Preventing construction in areas prone to risk can safeguard lives and livelihoods from extreme events. Nonetheless, it might entail foregoing valuable economic prospects. As a result, it may not be suitable to constrain all development undertakings in hazard-prone regions. For instance, it may not be appropriate to forbid actions if they constitute a crucial component of the community's economic foundation.
- Such determinations should be taken with the active engagement of stakeholders. A broad range of land utilization planning and administration tools (e.g., building regulations, impact evaluations, property and land tenure, urban service monitoring, awareness and education, etc.) can be employed to encourage sustainable development and risk endurance (Rodríguez *et al.*, 2007).

Constructing a city that is robust in the face of catastrophes encompasses more than just modifying land utilization and infrastructures. It must also bolster the proficiency of the community and interested parties to handle disasters and adjust to fluctuating circumstances (Godschalk, 2003).

***The contribution of protected areas in lessening the severity of catastrophes induced by climate change*:** Protected areas have agreed-upon boundaries, usually defined by law and physically demarcated, and operate under legal frameworks. Protected areas also have systems for establishing and regulating land tenure agreements, ranging from state-managed parks and wildlife reserves to indigenous reserves and locally managed areas. Protected areas are effective in preserving unspoiled ecological systems that provide protection against abrupt natural perils like surges, tempests, deluges, and landslides (Stolton *et al.*, 2015).

Natural vegetation cover is valued by populations as well as many residents of protected areas with natural resources for preventing floods and landslides brought on by extreme weather conditions. Protected areas provide three main benefits:

- Preserving natural ecological systems that mostly protect against sudden natural hazards such as high tides, storms, floods, and landslides (Amend, 2008).
- Maintaining traditional ecological systems and agricultural practices that are crucial for reducing the consequences of harsh weather, such as cultivating crops and fruit trees in arid regions to stave off the effects of drought and desertification (Amend, 2008).
- Allowing for the intentional or natural restoration of these systems in the event of their deterioration or loss (Dobson, 1998).

Protected areas' capacity to exist depends on how well their management and land-use plans work and how well local populations support them. Therefore, it can be concluded that protected areas can provide cost-effective and sustainable solutions for maintaining ecosystem services that decrease the

impact of natural risks and catastrophic outcomes. This support can only be created through increasing awareness of the multiple benefits provided by protected areas, including their contribution towards lessening the risks and consequences of disasters (Renaud, Sudmeier-Rieux and Estrella, 2013).

***Spatial planning to reduce the risk of disasters weather changes*:** The significance of the spatial component in mitigating disaster-related risks cannot be overstated. Since calamities have a geographically-specific impact, devising spatial plans at the local, regional, or global level becomes imperative in order to articulate, systematize, and regulate land use for diverse purposes, including but not limited to, agriculture, industrial enclaves, human settlements, and protected zones. However, given the exponential growth of the global populace, the implementation of such plans is increasingly fraught with challenges. Spatial blueprints play a critical and commanding role in forestalling or alleviating losses arising from hazards, as they dictate the physical placement of activities and investments. Moreover, they are of mounting importance in demarcating work zones and delineating the goals of spatial design (Sudmeier-Rieux *et al.*, 2019) include:

- Orchestrating the deployment of land and setting the stage for future urban or rural land use planning.
- Advancing sustainable growth encompassing social, ecological, and economic domains.
- Cultivating access to information and erudition.
- Bolstering and safeguarding the natural resources and cultural legacy.
- Achieving equilibrium among divergent interests and multifaceted needs.
- Curtailing the deleterious repercussions of perilous incidents through: curbing development in hazardous territories; accommodating and planning land use in accordance with risk gradations; engineering infrastructure to diminish hazards.

Strategic management is an intricate process of organizing and prioritizing activities, with the aim of optimizing the allocation of resources, streamlining operations, fostering collaboration among stakeholders, and realizing preconceived targets,This process entails a concerted endeavor that engenders judgments and undertakings that sculpt and orientate the very character of the organization, with an emphasis on the future trajectory. Additionally, this process demands a constant appraisal and modification of the course of the organization, in response to an ever-evolving milieu. The concept of strategic planning is related to the following cases (Maleka, 2014):

- There is a need for prediction.
- Seeking to achieve specific goals.
- The necessity of coordination in work.

Strategic land-use planning constitutes a crucial instrument in mitigating the impact of climate change on indigenous habitats and adjoining societies. The paramount objectives of land-use planning in the purview of climate change encompass safeguarding coastal environs, bolstering infrastructure, securing water reserves, and preserving arable terrains. By skillfully executing these goals, land-use planning can help to alleviate the damaging ramifications of climate change on a local, regional, and global scale. There is a particular need to develop approaches to strategic planning (Cumming and Allen, 2017):

- Placing local communities at the heart of decisions regarding appropriate land use in the future.
- Acknowledging the implementation of adaptation strategies that are grounded in ecosystem preservation as a financially efficient retort to climate change.
- Operating effectively within the context of limited human and financial resources.

***Study Area (Najaf Sea)*:** Najaf sea is located between latitudes (30,31-10,32) north, and longitudes (30,43-30,44) east. geographically, it is located in the banikya district in the middle of najaf province in iraq, as shown in figure 2. it is bordered to the north by the al-haidariya district and to the west by the western desert known as the "badia of najaf" or "shabaka". to the east are the city of najaf and the al-ridwaniya district. it is varying in width, as its southeast is (16 km^2), while it narrows in the middle to reach (10) km^2, and its total area is (435 km^2), equivalent to (1800 miles), with a length of (60 miles) and a width of (30 miles). its depth is estimated at (10 m) above sea level.

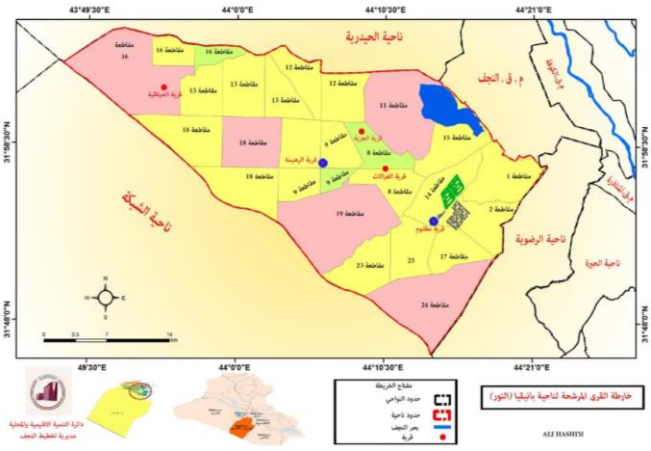

Figure 2. Illustrates the location of the Najaf Sea within the Banikya district (Source: Ministry of Planning, Regional & Local Development Dept, Planning Directorate of Najaf, 2022).

The establishment of the Najaf Sea Reserve has been proposed by the Directorate of Agriculture in Najaf, in the desert area of Shabaka district, about 50 km from the center

of Najaf Figure 3. This project Goals to develop the cultivation of wild plants and provide vegetative cover, as well as to make it a tourist area. It also aims to relocate rare animals such as ostriches and deer, and to relocate migratory wild birds, in addition to protecting the soil from erosion and desertification. The Najaf Sea area is a wide depression separated from the city of Najaf by a steep rocky slope called Tar of Najaf Fig. 3, and the adjacent areas slope towards it, making the area a basin that receives all the water from the adjacent high areas and heavy rains.

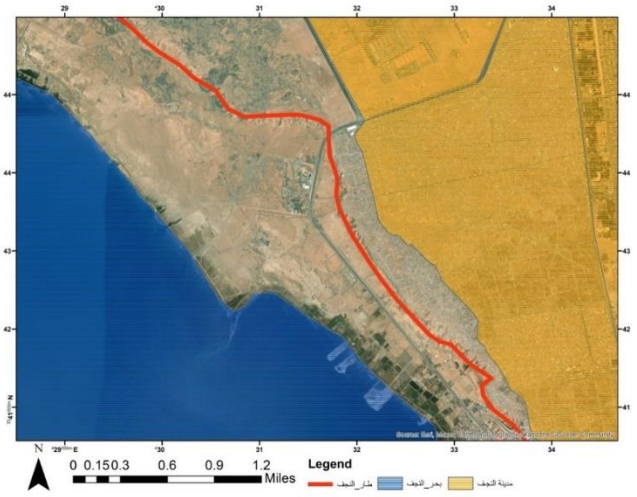

Figure 3. Location of the Tar of Najaf between the city of Najaf and the Najaf Sea. (Source: The researcher relied on Google Earth and ARC GIS software.).

***Climate changes in the Najaf Sea area*:** Iraq's history is full of natural disasters that have affected its environment, caused significant demographic changes, and led to the death of many of its inhabitants. It is impossible to imagine and evaluate the magnitude and impact of these events on Iraq's population and the changes they have brought about, such as human migration from one place to another to protect their lives from the effects and risks of natural disasters, such as droughts and flooding disasters that used to flood almost the central and southern regions of Iraq during the flood seasons of the Tigris and Euphrates rivers. The water levels in the Najaf Sea have fluctuated historically, and the scarcity of water in the Euphrates River has increased the population's vulnerability (Khalaf, 2021). The availability of water in the study area has led to the stability of its population due to the large population density and the limited expansion axes of the three cities of Najaf, thus increasing the area's susceptibility to climate changes, as happened in 2013 when rainwater flowed into the valleys' basins, in addition to the sudden rainfall coming from Saudi Arabia, which caused violent floods in a limited time and in large quantities that reached the study area, causing a disaster. The 2013 disaster was unexpected, as the residential areas that emerged during the drought seasons were not previously exposed to floodwater and flooding during the period they emerged, where the damaged areas contained modest buildings, informal settlements, and weak infrastructure, with a lack of sanitation services, exposing them to human, economic, environmental, and urban losses (Nassauer and Raskin, 2014). Figure 4 illustrates the changes that have occurred in the area of the Najaf Sea over the last 20 years:

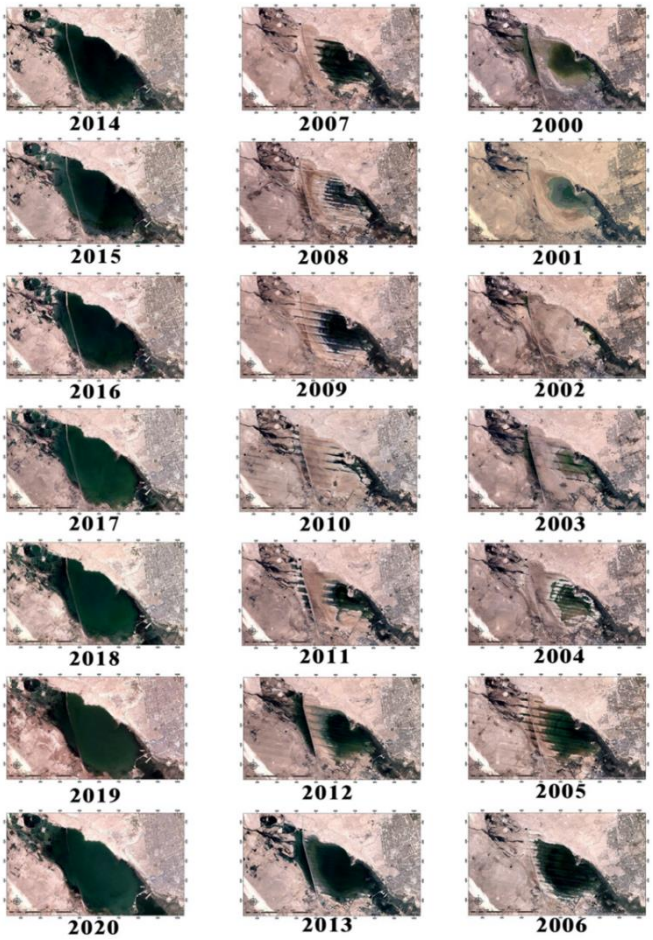

Figure 4. Changes in the Najaf Sea (Source: Prepared by the researcher using Google Earth and ARC GIS software.).

Solutions and plans to reduce desertification and climate extremism include

- Attracting international organizations that have programs to address desertification and climate extremism to Najaf Governorate, as it is the most affected by these phenomena, and activating the Sundai framework as it is specialized in this phenomenon.
- The possibility of working with the industrial rain or sprinklers in the soft areas of the western plateau, as the

green belts do not help to stop dust storms due to their height.
- Providing desert seeds and the possibility of planting them in the traditional way, or using dry and water (Drat Water) or Box Water solutions, or through modern scientific solutions.
- A plan to plant green areas inside the city neighborhoods, central islands, schools, departments, and encourage residents to plant by providing free seedlings.
- Building dams on the wadi stream in the Najaf desert to control rainwater and floods coming from Saudi Arabia and benefit from it in the desert.
- Continuing the green belt created by the Directorate of Agriculture in Najaf, with the establishment of new green belts, and directing the Department of Wells and Groundwater to dig irrigation wells in this belt.
- Ending the contracts of unused agricultural lands and obliging farmers to plant trees suitable for the desert environment.

Solutions and plans to reduce floods and torrents include
- Diverting the coming floodwater to the Najaf Sea through giant pipes installed by the competent authorities.
- Building an earthen dike around the Rahima area to protect it from floods and connecting it to the Najaf Sea, passing through the Azizia area.
- Increasing the depth of the Najaf Sea to increase the capacity to absorb the incoming water.
- Installing a standard water meter and directing well owners to implement the same model for the purpose of monitoring water consumption.
- Securing the land pilgrimage route by opening gates to the road towards the depression after securing a storage vacuum by operating pumping stations at Ain Al-Hasan pumping station.
- Installing half-meter mobile pumps to draw water from the land pilgrimage route.
- Removing mud deposits from the front of the Kufa Dam as part of a flood avoidance plan after preparing the appropriate sediment basin.

Recommendations
- Activating the laws protecting the environmental system of the Najaf Sea.
- Establishing a sanctuary for the Najaf Sea will help reduce overfishing, exploitation of agricultural land, enhance biodiversity, and limit tree cutting, thus promoting resilience to climate change.
- Activating environmental management to reduce the risks of floods, droughts, and other disasters.
- Incorporating sustainability in resource management will reduce costs, conserve the ecosystem, and, therefore, mitigate the perils of climate change.
- Enhancing the resilience of the environmental system of the Najaf Sea by making it a nature reserve, protecting it from damage, and minimizing pollutants in the region.
- Utilizing renewable energy in resource management reduces the effects of climate change, promotes social and economic advancement, and ensures a steady supply of energy.
- Implementing recommendations for reducing the danger of flooding and drought made by responsible organizations will help with reducing and preparing for the effects of climate change.
- Utilizing floodwater for storage and agricultural purposes can reduce the occurrence of drought.

Conclusions
- Climate change is defined as the changes in temperature, whether caused by natural or human factors, which lead to environmental consequences and risks that represent a global challenge and affect all aspects of life.
- Among the consequences of climate change are severe drought, water scarcity, intense wildfires, sea level rise, floods, melting polar ice, catastrophic storms, and the deterioration of biodiversity.
- Climate change affects physical and biological systems, and increases the rates of species migration.
- Climate change affects precipitation levels and can also affect water quality if extreme weather events such as droughts and floods become more frequent.
- Groundwater and surface water resources are affected by climate change and changes in temperature.
- Climate change threatens to undermine the value of ecosystem services and human well-being, as effects such as temperature increases may push the ecosystem beyond a threshold that leads to a different functioning system.
- Renewable energy has enormous potential to mitigate the effects of climate change, contribute to economic and social development, and provide a secure energy supply.
- The study area has been subjected to many climate changes resulting from temperature changes, such as drought periods in addition to floods, and the 2013 flood was the strongest among them.
- Creating a natural protected area in the region may help to preserve biodiversity and water resources, and thus reduce the severity of climate change.
- Flexibility helps in the process of adapting to climate change.

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Code Availability: none
***Consent to participate*:** none
***Consent for publication*:** none
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